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Enhancing Urban Sustainability and Resilience: An Assessment of the Bandung Smart City Master Plan (2018-2023)

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Abstract

This article examines the extent to which the Bandung Smart City Master Plan (2018-2023) promotes urban sustainability and resilience. As urbanization accelerates, cities face significant challenges, including traffic congestion, inadequate public services, and environmental degradation. The Bandung Smart City initiative addresses these issues by integrating technology and innovative governance strategies across six key dimensions: governance, branding, economy, living, society, and environment. This study uses qualitative analysis through a document study and thematic analysis to assess the effectiveness of the implemented strategies and their impact on urban sustainability. The qualitative analysis in this smart city master plan study focuses on an in-depth understanding of the city's conditions, needs, and potential from a non-numerical perspective. The findings reveal that while the smart city initiatives have made strides in enhancing public transportation, promoting electric vehicles, and improving public spaces, challenges remain in achieving inclusivity and comprehensive urban resilience. The research highlights the importance of aligning smart city objectives with measurable outcomes to ensure long-term sustainability. This study underscores the need for continuous improvement in smart city planning and implementation, advocating for a more integrated approach that considers the diverse needs of urban populations. The insights gained from this evaluation contribute to the broader discourse on smart city development and its role in shaping sustainable urban futures.

Keywords

Smart city; Urban sustainability; Urban resilience; Masterplan document; Bandung city

Introduction

Bandung City is the capital of West Java Province and has been named by UNESCO as a creative city, namely a city whose economy is supported by creative industries (Haryani, Putri and Jannah, 2024; Krysovatyy *et al.*, 2025). As a city based on creative industries, internet infrastructure support has become a daily necessity. Residents of Bandung City now have easy access to internet services through various means, including prepaid cards, Wi-Fi connectivity in private homes, and public facilities such as schools, libraries, parks, and places of worship. With this convenience and reliable infrastructure support, the people of Bandung have become accustomed to using the internet service for various needs and daily activities, including interacting in cyberspace and conducting financial transactions (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Eidowati and Nugroho, 2022). The people of Bandung City, driven by young people, are active users of information services and social networks. The young people of Bandung City also exhibit characteristics that tend to be active in the community and have a high level of physical activity.

Bandung City, characterized by rapid development and high urban dynamics, particularly with the widespread adoption of internet technologies, faces increasingly complex challenges that demand innovative and context-specific solutions (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Eidowati and Nugroho, 2022). The city's accelerated growth is accompanied by issues that threaten the continuity of a decent quality of life and undermine community resilience. Key concerns include economic disruptions, environmental degradation, and transportation inefficiencies, all of which require greater attention to ensure urban sustainability and public satisfaction. The Bandung City Government assesses that the smart city approach can address the urban problems and needs of the people in Bandung City by emphasizing six elements, namely smart governance, smart branding, smart economy, smart living, smart society, and smart environment (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Eidowati and Nugroho, 2022).

Gap and Rationale

Masterplan is one of the planning documents in Indonesia that provides guidelines and strategic planning to be implemented in more specific planning (Pemerintah Kota Bandung, 2021). Masterplan is a strategic process that involves practitioners from various backgrounds, namely planning, design, engineering, community engagement, and various other engineering fields (Ding, Huang and Xiao, 2023; Gavkalova *et al.*, 2025; Kravets *et al*., 2025). These practitioners then establish a vision, plan, and work program regarding the physical and functional design of the environment to be planned (Al Waer, 2014; Bell, 2005; Callway, Dixon and Nikolic, 2019; Carmona *et al*., 2010). The existence of this master plan is needed in the implementation of city planning that is more focused on the goals to be achieved.

This study aims to examine the Bandung Smart City Master Plan with a particular focus on its role in enhancing urban sustainability and resilience in Bandung City, Indonesia. Unlike routine evaluations typically conducted by city governments, which primarily assess the master plan as a procedural document and a general framework for

development, this study concentrates on evaluating specific aspects of the plan that directly influence sustainability and resilience outcomes. Government-led evaluations often adopt a broad approach and tend to overlook the tangible benefits of particular components within the master plan. Therefore, the findings of this study are intended to support the government in refining smart city planning and implementation, offering targeted insights to strengthen urban resilience and sustainability, needs that are becoming increasingly urgent in the current urban context.

Conceptual Framework

Urban planning is a series of process activities that are the initial part of the development of a city (Al Waer, 2014; Meerow and Newell, 2017). City planning is needed so that the development is directed by the goals to be achieved (Abdillah *et al*., 2023; Al Waer, 2014; Meerow and Newell, 2017). One of the objectives of urban development planning is to realize the city's desires. Although the concept of sustainability was originally part of the field of ecology, it has now been adapted to various other scientific disciplines (Yang and Wu, 2022), including development and urban planning. In planning, urban sustainability can be described as a balance between a city's specific needs, in environmental, social, and economic contexts (Michalina *et al*., 2021). Sustainability, which became known in the 1987 Brundtland Report and has increasingly been emphasized since the 1992 Rio Declaration on Environment and Development (Sharifi, 2021), has become one of the aspects that are in the spotlight in urban development, especially with increasing awareness of the importance of the role of environmental sustainability for holistic sustainability of human life in the future. Urban sustainability is an ongoing process to better prioritize human well-being, more effectively encourage and benefit from ecological processes and integrity, and promote social justice (Bautista-Puig *et al*., 2022; Pickett *et al*., 2013; Ruggerio, 2021).

To strive for urban sustainability, the solution proposed is often in the form of environmentally friendly infrastructure, which also addresses welfare issues and climate change (Langemeyer *et al*., 2021). Various strategies implemented to achieve these goals include increasing biodiversity, maintaining air quality, managing water resources, improving public health, and instilling values that can improve the quality of life and change human behavior (Demuzere *et al*., 2014; Gill *et al*., 2007; Meerow and Newell, 2017; Rao *et al*., 2022; Santiago Fink, 2016; Wamsler *et al*., 2016). Urban sustainability solutions can include different approaches. Important examples are environmental approaches like city greening, infrastructure improvements, and socio-institutional solutions that change how city governance works. These approaches are key aspects of urban sustainability (Babí Almenar *et al*., 2021; Croce and Vettorato, 2021; Rao *et al*., 2022; Singh *et al*., 2021). Urban sustainability is a vital aspect of promoting better human life quality, including urban resilience, which highlights the strengthening of urban systems in facing all kinds of threats and vulnerabilities in the future. Urban resilience is the capacity of cities and their communities to withstand disruptions, recover from disasters, and promote improved development for the welfare of their populations (Abdillah *et al*., 2023; Qiu *et al*., 2022). Urban resilience is also often considered a way to overcome the complex problems faced by a city (Wardekker *et al*., 2020; Meerow and Newell, 2017). Even though urban resilience is becoming popular among researchers today, its definition, the factors that influence it, and its implementation are still considered

unclear (Moser *et al*., 2019; Shamsuddin, 2020). However, considering the global urbanization trend and various natural risks such as current climate change, building urban resilience is very important as an urban necessity. One of the benefits of assessing city resilience is that it can be used by the government and relevant stakeholders in decision-making (Sharifi, 2020).

Evaluation of planning documents, including master plans, is not something new (Ding, Huang and Xiao, 2023; Tian and Shen, 2011; Yu *et al*., 2014). Evaluation of the master plan is usually carried out by the relevant regional government, but only based on the percentage of implementation of the program it carries out. Meanwhile, in academic circles, smart city evaluation has become a new trend with the rise of smart city development throughout the world, although it still faces many problems in its implementation, such as cognitive deficiencies, lack of experience in planning, and lack of coordination (Hsu *et al*., 2021). Meanwhile, the evaluation of the smart city master plan using the urban sustainability and urban resilience concept approach is based on the positioning of the smart city as a vehicle for achieving urban sustainability (Martin *et al*., 2019).

Literature Review

Some researchers have conducted previous studies similar to this study, like research from Ding, Huang and Xiao (2023) evaluated urban planning masterplan implementation in Changchun, China by comparing human activities data with the Changchun masterplan. The study result showed that the master plan cannot acquire the plan's desired outcome, though it did have its role in guiding human activity patterns (Ding, Huang and Xiao, 2023). While Buzási, Jager and Hortay (2022) assessed Hungarian cities' urban sustainability and heatwave vulnerability using a spatio-temporal perspective. This study used socio-economic statistical data and vulnerability dimensions that are relevant to climate change and environmental issues. The application of the fuzzy logic approach showed the correlations between socio-economic aspects and the spatial characteristics, such as heatwave duration predictions. This study resulted in conclusions that Budapest and Western regions had higher sustainability scores and lower vulnerability levels than other regions that under underdeveloped (Buzási, Jager and Hortay, 2022). Li *et al.* (2020) tried to propose an evaluation system and applied it to assess smart cities in China. This study revealed that the evaluation system is a key guiding tool for comprehending China's overall smart city platform construction status. Comparative assessments of the indicators show that China should focus more on developing unique ideas, building dynamic information resources, and spatiotemporal big data in the future when building smart cities (Li *et al*., 2020). Kourtzanidis *et al.* (2021) explored a framework to assess the impact, performance, and sustainability of smart cities projects simultaneously and resulting in the Uniform Smart City Evaluation (USE) framework (Kourtzanidis *et al*., 2021). Conversely, Hodson *et al.* (2023), tried to discuss the smart city assessment in a single specific aspect, namely social impact and transportation system, respectively. Hodson *et al*. (2023) looked at the reasons behind, definitions of, approaches used in, and difficulties associated with assessing the social effects of smart city services and technology (Hodson *et al*., 2023). Yan and Wu attempted to characterize smart city development and used three dimensions (smart cells, ICT, and developmental mechanism) to evaluate the smart transportation system (Yan and Wu, 2022).

Even though many related studies have been carried out, previous research equally agrees that the urgency of city planning and urban transformation needs to be carried out by encouraging the ability of city systems in smart city transformation to realize urban resilience and sustainability, so that cities are safer, more comfortable, and easier to live with. This is done considering that currently urban areas are facing urban threats due to climate change (Elmqvist *et al*., 2019), globalization and high urbanization, in addition to the urgency of the role of cities in a country's economic growth (Elmqvist *et al*., 2019), making cities need to receive serious attention by policy makers, urban planners and researchers. Scholars regarding urban planning and transformation carried out. This study brings a different point of view and goals in smart city masterplan evaluation in Indonesia. This evaluation needs to be conducted in order to understand how the smart city implementation in Bandung City can contribute to urban sustainability and urban resilience based on its concept. The understanding of urban sustainability and urban resilience regarding smart city masterplan evaluation will be beneficial to escalate the government's efforts to achieve the long-term goal of the smart city masterplan, namely, the well-being and welfare of the citizens.

Methodology

This research employs a qualitative exploratory approach following Creswell and Poth (2016), Widianingsih *et al.* (2023), and Shi, Zhang and Jiang (2023), utilizing secondary data and literature reviews to investigate urban issues in Bandung City. The document study method is particularly valuable here, as it provides valid, efficient, and evidence-based insights, enabling a deeper analysis of social phenomena, policy frameworks, historical developments, and the complexity of urban challenges. This qualitative approach allows for an in-depth exploration of the social dynamics, stakeholder interactions, and contextual factors influencing smart city initiatives. Unlike purely quantitative methods, it offers nuanced perspectives on motivations, barriers, and collaborative processes critical to smart city development. The study specifically evaluates the implementation of the Bandung Smart City Master Plan, using the frameworks of sustainability and urban resilience (Sharifi, 2020, 2021). These concepts serve as key indicators in assessing environmental justice, urban quality of life, and the city's contributions to global environmental sustainability (Thomas, Hsu and Weinfurter, 2021).

In analyzing the implementation of the smart city master plan on urban sustainability, we use an urban sustainability approach, which is explained by four dimensions, namely environmental, economic, social, and institutional. Michalina *et al.* (2021) stated that each of these four dimensions is categorized into thematic categories that explain their scope of dimensions. Table 1 shows the categories of urban sustainability dimensions that were used for the study.

The concept of urban resilience used in this study is based on the framework developed by Shi, Zhang and Jiang (2023), which comprises four key dimensions: social resilience, economic resilience, infrastructure resilience, and ecological resilience. Each of these dimensions is represented by a set of specific indicators, as outlined in table 2.

Table 1: Categories of urban sustainability dimensions

Dimension	*Categories*
Environmental	Water Mobility and transport Waste Air quality Energy Land use Climate change
Economic	Economy Employment
Social	Education Health Housing Safety and security Equity (social, economic) Social infrastructure Green space Culture
Institutional	Participation Urban planning Environmental management Governance

Source: Michalina *et al.*, (2021)

Table 2: Indicators of urban resilience dimensions

Dimension	*Indicators*
Social resilience	Unemployment rate Number of college students per 10,000 people Number of basic medical insurance participants Health technicians per 1000 population
Economic resilience	GDP per capita Disposable income per capita Per capita consumption expenditure Financial revenue
Infrastructure resilience	Road area per capita Number of buses per 10,000 people Number of internet broadband subscribers Drainage pipe length
Ecological resilience	Greening coverage of built-up areas Harmless disposal rate of domestic waste Annual city water supply Urban sewage treatment rate

Source: Shi, Zhang and Jiang (2023)

The data sources in this research are the Bandung Smart City Masterplan Book I, Book II, Book III, as well as the Final Report on the Evaluation of Bandung Smart City Tool Models and Assessment. These planning documents will serve as a reference for the plans

that have been prepared and the general evaluation carried out by the Bandung City Government, Indonesia.

Data collection

Data for this study were collected through secondary sources, primarily via a desk study of planning documents from the Bandung City Government. These included Master Plan Books I, II, and III, as well as the Final Report on the Evaluation of the Bandung Smart City Tool Models and Assessment. Additionally, a literature review was conducted to examine key concepts and methodologies relevant to this study, particularly those related to urban sustainability and urban resilience. As a preliminary step in evaluating the Bandung City Smart City Master Plan, a word frequency analysis was conducted to identify commonly occurring terms within the document. The most frequently mentioned words are presented in figure 1, offering readers an overview of the core themes and focus areas of the Bandung Smart City Master Plan.

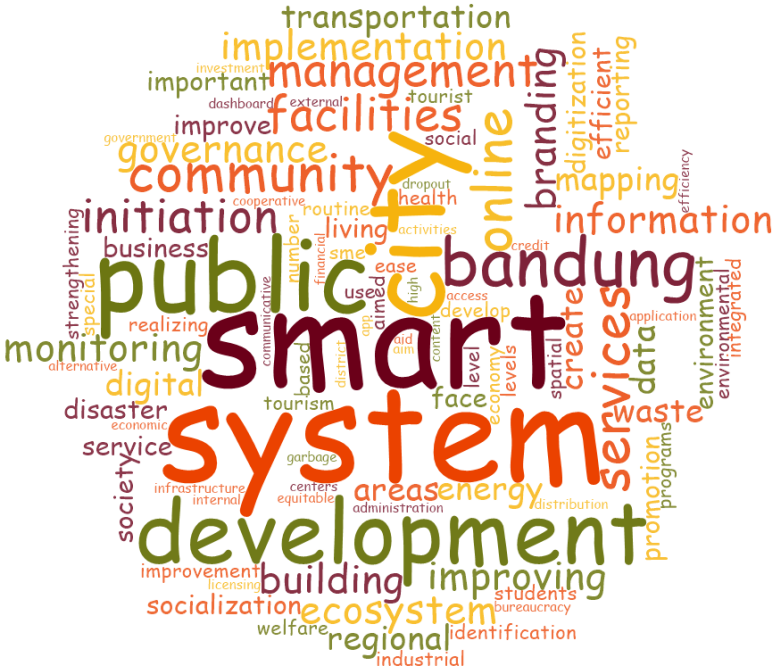

Figure 1: WordCloud identification and analysis of the 2018-2023 Bandung City Master Plan Document.

Data analysis

This study employs a data analysis process based on descriptive, qualitative, and interactive analytical techniques. The process includes data collection, data identification, reduction of data relevant to the research topic, data verification, presentation, and conclusion drawing, following the framework of Miles, Huberman and Sadana (2014) and Woolf and Silver (2017). To support the analytical process, the qualitative data analysis software NVivo 12 Plus was used, as illustrated in figure 2. Substantively, this study adopts a conformance-based evaluation approach as outlined by Laurian *et al.* (2004),

which emphasizes the alignment between planning outcomes and stated objectives. In this context, the evaluation focuses on assessing the extent to which the Bandung City Smart City Master Plan aligns with its intended goals of promoting urban sustainability and urban resilience.

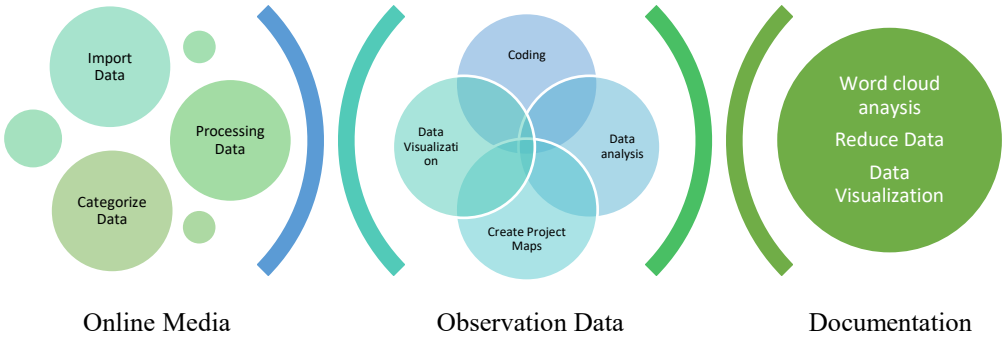

Figure 2: Research method of analyzing data via NVivo 12 Pro. *Source*: Woolf and Silver (2017)

Results and Discussion

Implementation and Planning Objectives in the Smart City Master Plan Document for Bandung City, Indonesia: An Overview

To create an advanced and technology-based urban system, the Bandung City Government is developing a concept called "Bandung Smart City" (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022), contained in the master plan (Master Plan) for the development of Bandung City. The city of Bandung focuses on building a smart city by emphasizing elements of digital technology, such as prioritizing big data discourse, infrastructure development, and how to use it to create applications or web-based public services (Bandung City Government, 2021). The key consideration is not the number of digital technology services, but how individuals utilize them to enhance social and cultural life and actively participate as urban residents (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). As Foth (2018) has explained, the level of participation of city residents in the context of smart cities can be seen from the joint development between the government and its citizens in developing cities. The implementation of the smart city masterplan in Bandung City was preceded by defining six main goals as development strategies, shown in table 3.

Table 3: Overview of Master Plan Smart City Kota Bandung, Indonesia

No.	*Focus Area*	*Objectives*	*Strategy*
1.	Smart governance	Smart governance aims to create regional governance and administration that is effective, efficient, communicative, transparent, accountable, and continues to improve democratic performance through innovation and the application of integrated technology.	• Improving the quality of public service. • Improving the efficiency of bureaucracy. • Improving the efficiency of public policy.
2.	Smart branding	Smart branding, aimed to improve regional competitiveness with the face of the city's arrangement and regional potential in local, national, and international scope.	• Building tourism branding. • Building business branding. • Building city appearance branding.
3.	Smart economy	Smart economy aims to create an ecosystem that can promote the community's economic activities that conform to the regional leading economic sector that is adaptive to the changes in the information era, and to improve the public's financial literacy.	• Building a competitive industry ecosystem. • Improving welfare. • Building transaction's ecosystem.
4.	Smart living	Smart living, aimed at creating a livable, comfortable, and efficient living environment.	• Harmonizing regional spatial planning. • Improving health infrastructure. • Ensuring the availability of transportation facilities.
5.	Smart society	Smart society, aimed to create a humanistic and dynamic socio-technical ecosystem, both physical and virtual, to create a productive, communicative, and interactive society with high digital literacy.	• Realizing efficient community interaction. • Building an efficient learning ecosystem. • Creating a community security system.
6.	Smart environment	Smart environment, to realize good, responsible, sustainable, and sustainable-friendly governance.	• Develop environmental protection programs. • Develop waste and waste management. • Developing responsible energy governance.

Based on table 3 on the implementation of smart city in Bandung City, there are several problems related to these strategies and policies, including inadequate information regarding public services and transparency of service availability, as well as a lack of control over service procedures. Apart from that, to improve the branding of Bandung City, optimization and improvements have been made to tourist attractions in the city; however, access to public transportation and parking areas is still not optimal. Meanwhile, regarding creative industry branding, there are still obstacles in marketing and strengthening "one village one product" (Pemerintah Kota Bandung, 2018; Pramadi, Fathy

and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). The optimization carried out by the Bandung City Government has had an impact on improving the economy, especially in the SME sector, although it is still not optimal. There are many aspects that need to be improved, especially regarding the specifics of the economy, public infrastructure, and regulations (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022.

Implementing strategies for smart living also faces difficulties in the health and transportation sectors. In the health sector, the problems that occur include the limited availability of medical doctors as well as health services and inpatient. The quality of current healthcare services is lacking and can be improved through technological integration, enhancing accessibility for individuals. Meanwhile, in the transportation sector, there are still complex and unresolved problems, which can be seen in the traffic jam problems that people in the city of Bandung still experience (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). Private traffic jams are caused by many factors, including inadequate traffic management and minimal use of public transportation. The minimal use of public transportation is the result of various other problems, such as public transportation facilities that are less comfortable and public transportation facilities that are less reliable, so people prefer to use private vehicles. Congestion that continues to occur is detrimental to society and, in the long term, can reduce community resilience (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022).

The impact of implementing a smart society in the city of Bandung is shown by the easier interaction and growth of the learning ecosystem. However, there are still problems that occur, especially in the education sector, as well as security and disasters (Abdillah *et al*., 2023; Kurniasih *et al*., 2023). In the education sector, there are still many problems being faced, including a shortage of teaching staff, unequal distribution of school facilities and classrooms, and a lack of optimal education services. Apart from that, security and disaster issues have not been resolved properly, namely the lack of an established community security system, including the availability of an early warning system, mapping of disaster-prone areas, and disaster mitigation (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022).

The implementation of this smart environment still leaves a lot of room for improvement. One of the main problems that has not been resolved is waste management, which is not yet optimal as a result of the absence of a Final Disposal Site (TPA). Apart from that, there are still energy management problems, namely the high use of fossil fuels and the minimal implementation of energy savings (Pemerintah Kota Bandung, 2018; Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). Based on this, the strategy for implementing Smart City in Bandung City must ensure that all parties work well together through good communication. Not only building infrastructure but also encouraging empowerment, including community development and participation (Abdillah *et al*., 2023; Kurniasih *et al*., 2023). The government invites people throughout society to take part in building smart cities. The development and progress of the city will benefit its residents. van Waart, Mulder and de Bont (20216) and Effing and Groot (2016) stated that urban innovation in the smart city scheme requires public participation in it, for Levenda

et al. (2020) also state that public and technology are part of Smart City. Conversely, the effectiveness of urban facilities and technologies is contingent upon the active involvement of residents throughout the processes of development, utilization, and maintenance. Without this engagement, the potential of these systems to function optimally is significantly diminished. The realization of this smart city is supported by citizen involvement. For example, through two-way communication that actively involves the community in voicing their desires for city improvement, especially now that applications are starting to emerge that can fulfill the aspirations of the wider community (Castelnovo, Misuraca and Savoldelli, 2016; Khan *et al*., 2017).

The successful implementation of the smart city master plan aims to enhance urban sustainability and resilience in Bandung, Indonesia (Pemerintah Kota Bandung, 2021). However, in practice, the implementation of the master plan often deviates from its original design, resulting in a gap between the planned objectives and the actual conditions observed on the ground (Pemerintah Kota Bandung, 2021; Shi, Zhang and Jiang, 2023). Based on the Final Evaluation Report of the Bandung City Government, some problems were not resolved in the implementation of the smart city master plan, so the government formulated initiatives based on these gaps. These initiatives are then grouped based on their priority scale (See Figure 3). From these initiatives, we can see that these parts have not benefited from the implementation of the Bandung City smart city master plan, and from the priority scale, we can see which parts are prioritized by the government (Pemerintah Kota Bandung, 2021). This aligns with Sharifi (2020, 2021), who emphasizes that building and assessing urban sustainability and resilience requires: (1) the provision of essential urban services; (2) consideration of the multi-dimensional nature and key pillars of urban resilience; (3) integration of major socio-economic and environmental issues; and (4) the support of information and communication technologies (ICT) alongside active community participation.

This approach is valuable for identifying the strengths and weaknesses in the implementation of the smart city initiative in Bandung, highlighting gaps in execution and areas requiring immediate attention. It also helps assess the extent to which smart city-based urban planning and management contribute to promoting urban sustainability and resilience. The discussion of the master plan implementation in the context of urban sustainability and urban resilience will be explained below based on the six dimensions of the smart city of Bandung City, Indonesia.

1. Smart governance

This smart city dimension includes efforts to improve the quality of public services, efficiency, and public policy efficiency, with evaluation scores for the implementation of the master plan carried out by the Bandung City Government, namely 97.5, 77.5, and 80, respectively (Pemerintah Kota Bandung, 2021). However, this value is a percentage of the achievement of plan implementation, which cannot yet reflect the fulfillment of the needs of the city and its people, especially in supporting urban sustainability and urban resilience (Pemerintah Kota Bandung, 2021). Smart governance aims to enhance the urban sustainability of Bandung City within the institutional framework, potentially bolstering community resilience. A detailed examination of this governance dimension can be

conducted by analyzing initiatives that address identified gaps following evaluations. The following are initiatives for gaps in smart governance and their priorities (see Table 4).

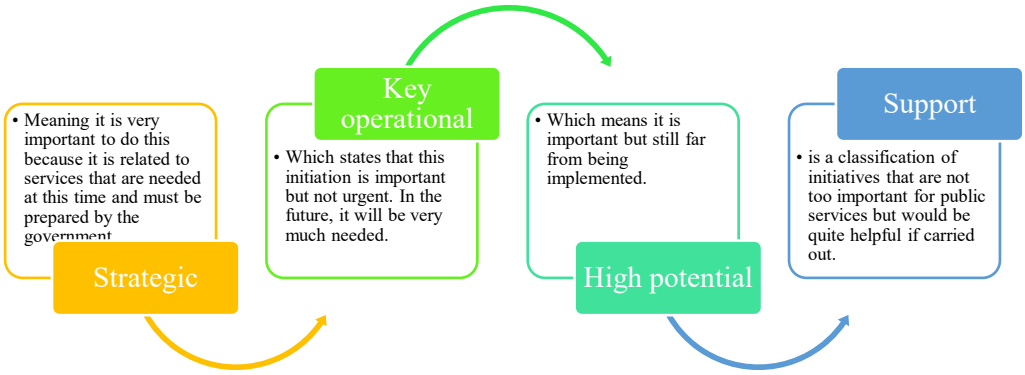
• Meaning it is very important to do this because it is related to services that are needed at this time and must be prepared by the government
Strategic
Key operational
• Which states that this initiation is important but not urgent. In the future, it will be very much needed.
• Which means it is important but still far from being implemented.
High potential
Support
• is a classification of initiatives that are not too important for public services but would be quite helpful if carried out.

Figure 3: Measures for assessing priorities for implementing the Smart City Master-Plan for Urban Sustainability-Resilience. *Source:* Sharifi (2020, 2021)

Table 4: Initiatives based on the gap in smart governance

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	All city administration services are online-based	Strategic	Institutional (governance)	Infrastructure
2.	Internal and external (community) service dashboard	Key operational	Institutional (governance)	Infrastructure
3.	Public service complaint channel (reporting system)	Strategic	Institutional (participation)	Infrastructure
4.	Online reporting system for the public	Strategic	Institutional (participation)	Infrastructure
5.	United Nations online services	Strategic	Institutional (governance)	Infrastructure
6.	*Sabilulungan* (local wisdom that goes beyond just prioritizing cooperation behavior) for social assistance and grants	Key operational	Social	Social
7.	Online queuing system for public services	Key operational	Institutional (governance)	Infrastructure
8.	E-office for disposition, correspondence, and bureaucracy	Strategic	Institutional (governance)	Infrastructure
9.	Government service management dashboard for	High potential	Institutional (governance)	Infrastructure

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
	monitoring internal and external services			
10.	Centralized attendance and personnel information system	Strategic	Institutional (governance)	Infrastructure
11.	Vehicle management information system (*Sistem Informasi Manajemen Kendaraan*, SEMAR)	High potential	Institutional (governance)	Infrastructure
12.	Financial report record information system	Strategic	Institutional (governance)	Infrastructure
13.	The mayor and public officials schedule an application for ease of procedures and work needs.	High potential	Institutional (governance)	Infrastructure
14.	Open data for the public	Strategic	Institutional (participation)	Infrastructure
15.	Community involvement regarding problems or new city policies through the Development Planning Conference (*Musrembang*).	Strategic	Institutional (participation)	Social
16.	Online channel planning policy.	Strategic	Institutional (urban planning)	Infrastructure

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment, 2024

Based on this data, it appears that the government's main priority for developing smart governance is largely focused on online-based government governance and community services, such as e-office, city administration services, reporting systems, and others (Pemerintah Kota Bandung, 2021). Increasing quality and efficiency in this smart governance dimension can generally improve urban sustainability institutionally (Castelnovo, Misuraca and Savoldelli, 2016; Effing and Groot, 2016; Michalina *et al*., 2021). Increasing bureaucratic efficiency and public policy can improve the performance of government officials and the quality of the public policies they produce. Meanwhile, improving the quality and efficiency of public services can be felt directly by the community, and can effectively and efficiently increase community resilience, not only socially, but also economically, through increasing infrastructure resilience in the form of providing technological and digital facilities (Hodson *et al*., 2023; Hsu *et al*., 2021). The ease with which people can access public services can increase productivity by cutting the bureaucratic routes that people usually have to take to get these services. The bureaucratic routes that people usually have to take to get public services force people to take time off from their daily work because public services can generally only be accessed on weekdays (Pemerintah Kota Bandung, 2021). With the increase in online services, people can get government services from anywhere and at any time without having to sacrifice significant time.

2. Smart branding

The implementation of smart branding in Bandung City is also evaluated by the government, which includes tourism branding targets with a score of 83.3, while business branding is 66.7, and city appearance branding is 84. The average score is not higher than the previous dimension. When viewed based on the urban sustainability dimension, this smart branding dimension has a long-term goal in the form of economic sustainability, namely building a tourism and investment climate in Bandung City, Indonesia (Pemerintah Kota Bandung, 2021). However, if we look at the initiatives one by one, it appears that this dimension can also support environmental and institutional sustainability. Meanwhile, for urban resilience, smart branding plays a role in economic and infrastructure resilience, with economic resilience as the ultimate goal (see Table 5).

Table 5: Initiatives based on the gap in smart branding

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	Identification, renovation, and repair of Bandung City tourist attractions	Strategic	Environmental Economic	Economic Infrastructure
2.	Ecosystem development and strengthening tourist area access and facilities	Strategic	Environmental Economic	Economic Infrastructure
3.	Routine socialization of conventional tourist areas	Key operational	Economic	Economic
4.	Development of GIS-based integrated tourist destination applications for tourism promotion	High potential	Economic	Economic
5.	Add-ons trip planner web/mobile for integrated tourism applications	High potential	Economic	Economic
6.	Basic tourism training	High potential	Economic	Economic
7.	Initiation, strengthening, and introduction of local products on a regular and measurable basis	Strategic	Economic	Economic
8.	Promotion of Bandung City's superior brands through Stunning Bandung	Strategic	Economic	Economic
9.	Construction of a city facade that characterizes the face of Bandung City	High potential	Environmental	Infrastructure
10.	Promotion and strengthening of Bandung City's facial content	Strategic	Economic	Economic
11.	Bandung City's spatial monitoring system to monitor the face and spatial layout of Bandung City	Key operational	Institutional (urban planning)	Infrastructure

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment and Analysis Results, 2024

Based on the data above, it appears that the Bandung City Government wants to focus on physical planning and creating branding that can encourage the city's economic sustainability and economic resilience. The branding that the government wants to do starts with the physical arrangement, which will have an impact on the arrangement of the city's infrastructure and environment (Pemerintah Kota Bandung, 2021). Therefore, serious implementation of smart branding can be the starting point for environmental sustainability and infrastructure resilience. However, consistency is needed, especially in maintaining infrastructure and the environment, so smart branding alone is not enough to ensure environmental sustainability and infrastructure resilience.

3. Smart economy

This dimension focuses heavily on economic sustainability and resilience. Two out of three aims directly address problems in the economic ecosystem. First, the government tried to build a competitive industry ecosystem that scored 76 as a result of its assessment. Second, they also focused on building a transaction ecosystem that will utilize technology, such as cashless methods and e-commerce, which gained a score of 72.7. While another aim is to improve welfare, because welfare and economy cannot be discussed separately, welfare can be achieved by improving the economy. This aim had the highest score of the three, which is 82.6 (Pemerintah Kota Bandung, 2021). The implementation left gaps to fulfil the needs and resulted in initiatives stated below (see Table 6).

Table 6: Initiatives based on the gap in the smart economy

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	Development of special or sub-district-based industrial areas	Key operational	Institutional (urban planning)	Infrastructure
2.	Mapping and monitoring system for industrial areas and business centers in Bandung City	Strategic	Economic Institutional (urban planning)	Economic
3.	Special area for marketing industrial products for ease and variety of sales	Key operational	Economic	Infrastructure
4.	SME development to improve the welfare of citizens	Strategic	Economic Social (equity)	Economic
5.	Promotion system and implementation of trade missions for SME products	Strategic	Economic	Economic
6.	One village, one product	High potential	Economic	Economic
7.	Digitalization of UKM data and mapping of MSME areas (including street vendors)	Strategic	Economic Social (equity)	Economic
8.	Cooperative development and increasing business capacity through credit	Strategic	Economic	Economic
9.	Ease of licensing for investment	Strategic	Economic	Economic

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
			Institutional (governance)	
10.	Monitoring and reporting system for SMEs, Cooperatives, and Credit	Key operational	Economic Institutional (governance)	Economic
11.	Investment licensing and reporting monitoring system	Strategic	Institutional (governance)	Economic
12.	Digitizing poverty data for mapping poverty and social assistance	Strategic	Social (equity)	Social
13.	Initiation of cashless payments for business centers, MSMEs	Key operational	Economic	Economic
14.	Initiation and implementation of online retribution	High potential	Economic	Economic
15.	E-commerce implementation	High potential	Economic	Economic

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment and Analysis Results, 2024

As stated earlier, this dimension will mainly affect economic sustainability and resilience. However, other dimensions of sustainability and resilience will be affected by this smart city dimension, such as social and institutional sustainability, and infrastructure and social resilience. Based on the priority pinned by the government, the strategic initiatives mainly try to encourage industry and investment climate, while supporting SME's existence, which has become a pillar of Bandung's economy, also to improve the handling of social welfare problems using digitalization (Pemerintah Kota Bandung, 2021). Besides the problem of social welfare that addressed social problem, the intervention of the government in industry, investment, and SME will directly impact the city's economy. But they will also have a side effect on social sustainability, especially in the SME sector. The government's help in the SME sector will increase the equity between entrepreneurs. The initiatives related to regulations also support institutional sustainability because it heavily involved the government agencies and related stakeholders (Pemerintah Kota Bandung, 2021).

4. Smart living

This dimension focuses on harmonizing regional spatial planning, improving health infrastructure, and ensuring the availability of transportation facilities. The government assessed the implementation of this dimension and resulted in more than 70 in scores. The regional spatial planning gained 80, health infrastructure 83.3, while transportation facilities 73.3, though these scores only represent the availability and are not based on the quality or the fulfilment of people's needs (Pemerintah Kota Bandung, 2021). This assessment also resulted in initiatives that were generated from the gap between the implementation and the needs (see Table 7).

Table 7: Initiatives based on the gap in smart living

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	Standardization of the number and facilities of green open space (city forests, parks, etc.)	Key operational	Environmental (air quality, land use) Institutional (urban planning) Social (green space)	Infrastructure
2.	Improvement of public facilities and infrastructure (special toilets, facilities for the elderly and disabled)	Key operational	Social (equity)	Infrastructure
3.	Open space surveillance system	Key operational	Institutional Environmental Social (green space)	Environmental
4.	Management and supervision of public spaces	Strategic	Institutional	Social Infrastructure
5.	Addition of hospitals/inpatient rooms	Strategic	Social (health)	Infrastructure Social
6.	Online reservation/queuing system for outpatient care	Key operational	Social (health)	Social
7.	Digitization of patient data for referral systems and medical records used from the health center to the hospital level	Strategic	Social (health)	Social
8.	Digitalization and mapping of People with Social Welfare Problems (*Penyandang Masalah Kesejahteraan Sosial*, PKMKS).	Strategic	Social (equity)	Social
9.	PMKS monitoring system for program assistance	Strategic	Social (equity) Institutional	Social
10.	Increasing the quality and quantity of health workers, especially doctors and nurses, at the community health center level	Strategic	Social (health)	Social
11.	Development of an online consultation system	Key operational	Social (health)	Social
12.	Emergency system for health services	Strategic	Social (health)	Social
13.	Socialization and implementation of the use of public transportation	Strategic	Environmental (mobility and transport)	Social
14.	ATCS and ATMS for handling traffic jams	Strategic	Environmental (mobility and transport)	Infrastructure
15.	Public transportation information system for easy access to public transportation	Strategic	Environmental (mobility and transport)	Infrastructure

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
16.	Improvement of public transportation facilities for traffic comfort and safety	Key operational	Environmental (mobility and transport)	Infrastructure
17.	Development of electric vehicles	Support	Environmental (mobility and transport)	Infrastructure

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment and Analysis Results, 2024

From these initiatives, we can see that Bandung City still faces problems with public spaces, inclusivity in infrastructures, health services, and transportation. However, not all of them are prioritized by the government. The strategic initiatives include improvements in health services and infrastructures, people with social welfare problems, and the transportation system (Pemerintah Kota Bandung, 2021). The improvements in health services and social welfare will encourage social sustainability and social resilience in Bandung City, while transportation will support infrastructure resilience and environmental sustainability, especially in mobility and transport. Social sustainability and social resilience, which are tried to be achieved by addressing social welfare problems and improving health services, can create a society that can thrive to exist in a healthy and equal way among citizens. While transportation improvement will affect the quality of the environment and boost infrastructure resilience with diminishing congestion and increasing ease of mobility, this can be advantageous for society in the long term, especially in bolstering its economic resilience. The transportation problem that is still faced by Bandung City impacts inefficient mobility, which costs people time and money, thus reducing their productivity. Smart living dimension can be described as a way to integrate social and physical (environmental and infrastructure) aspects in urban planning. As stated by Duman and Asilsoy (2022), social sustainability is closely related to the impact of environmental quality on human well-being from a humanistic perspective. Fulfilling citizens' needs inclusively is a paramount intention to create a socially sustainable built environment. (Duman and Asilsoy, 2022).

5. Smart society

The smart society dimension is designed to improve social sustainability and social resilience. However, the main focus is still on education, that listed as mandatory spending in the regional revenues and expenditures budget (APBD). The improvement in education can impact on the better quality of society, thus it gets the most attention from the government. The government's evaluation indicated that the education sector, aligned to foster an efficient learning ecosystem, achieved a score of 80. In contrast, the aims of efficient community interaction and community security received scores of 64 and 70.9, respectively. Besides education, early warning systems and disaster mitigation are also prioritized, regarding the importance and the absence of a reliable system (Pemerintah Kota Bandung, 2021). Table 8 shows the initiatives of this dimension with the priority scale and what they support in urban sustainability and urban resilience.

Table 8: Initiatives based on the gap in the smart society

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	Identification and monitoring of community, youth, and sports organizations	High potential	Social (culture)	Social
2.	Digital community initiation	High potential	Social (culture)	Social
3.	Developing a portal/system to interact and communicate with NGOs and the public in the digital world	Strategic	Social (culture)	Social
4.	Addition/management of the number of schools and classrooms for an even distribution of students at the sub-district and village levels	Strategic	Social (education)	Social
5.	Increase in the number of certified teachers and accredited schools	Strategic	Social (education)	Social
6.	Strengthening and equalizing school facilities at the sub-district and sub-district levels	Strategic	Social (education)	Social Infrastructure
7.	Minimize the dropout rate through classroom and test packages, as well as the identification of out-of-school students.	Strategic	Social (education)	Social Infrastructure
8.	Counseling system for parents, teachers, and students	Key operational	Social (education)	Social
9.	Development and management of digital content for sharing materials throughout the school	Key operational	Social (education)	Social
10.	Mobile Department of Education and Culture for education services anywhere and anytime	Key operational	Social (education)	Social
11.	PPDB online	Strategic	Social (education)	Social
12.	Early warning system for security and disasters	Strategic	Social (safety and security)	Social
13.	Digitalization and mapping of disaster-prone areas	Strategic	Social (safety and security)	Social
14.	Shield application for public security information	Key operational	Social (safety and security)	Social
15.	Disaster management master plan (disaster mitigation)	Strategic	Social (safety and security)	Social

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment and Analysis Results, 2024

From table 8, we can conclude that the government tries to improve social sustainability and social resilience through education and disaster management. Improvement in

education infrastructure and service will support the overall quality of education, thus improving the quality of life of the citizen, and in the long term, it will also contribute to economic improvement. Disaster management is essential for enhancing urban resilience, especially in flood-prone areas like Bandung City, which is situated in a basin and surrounded by numerous faults (Pemerintah Kota Bandung, 2021). Having an early warning system and a disaster management masterplan will be advantageous for improving city resilience, including community resilience. Better disaster management will help people avoid disasters and cope with the disruption they cause. Therefore, the improvement in disaster management will encourage the social sustainability and social resilience in Bandung City (Pemerintah Kota Bandung, 2021).

6. Smart environment

Smart environment dimension focuses on three items they are environment protection program, waste management, and responsible energy management. This dimension specifically targets environmental sustainability and ecological resilience. Based on evaluations carried out by the Bandung City Government, there are still many plans in the master plan that have not been realized, as indicated by realization scores of 84, 76.4, and 60, respectively, for targets 1, 2, and 3 (Pemerintah Kota Bandung, 2021). The implementation of this smart environment dimension leaves a gap, which gives rise to the initiatives in table 9.

Table 9: Initiatives based on the gap in the smart environment

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
1.	Resident development program to carry out environmentally friendly activities	Strategic	Environmental	Ecological
2.	Internet-based real-time environmental sensor repair and automation	Strategic	Environmental (air quality)	Ecological
3.	Routine and comprehensive evaluation of air, water, and soil conditions to prevent pollution	Strategic	Environmental (water, air quality) Institutional (environmental management)	Ecological
4.	Socialization and implementation of waste/garbage separation at the household level	Strategic	Environmental (waste)	Ecological
5.	Initiation and assessment of TPA development in the city.	Strategic	Environmental (waste)	Ecological
6.	Waste sorting at the temporary waste storage (*tempat penampungan sampah sementara*, TPS) level.	Strategic	Environmental (waste)	Ecological
7.	Waste sensor for daily waste transportation.	Key operational	Environmental (waste)	Ecological

No.	*Initiatives based on the Gap*	*Priority*	*Urban sustainability dimension*	*Urban resilience dimension*
8.	Sosialisasi rutin (konvensional/digital) untuk penghematan energi	Strategic	Environmental (energy)	Ecological
9.	Use and development of alternative energy (all street lights are solar-based)	High potential	Environmental (energy)	Ecological
10.	City energy usage monitoring system	High potential	Environmental (energy) Institutional (environmental management)	Ecological
11.	Initiation of alternative energy development	High potential	Environmental (energy)	Ecological

Source: Final Report on Evaluation of Bandung Smart City Tool Models and Assessment and Analysis Results, 2024

By referring to the priorities set by the government for each initiative, it appears that the government's focus in managing the new environment is on waste and waste management. This is understandable considering that the waste problem in Bandung City is still not resolved and is of concern to many parties (Pemerintah Kota Bandung, 2021). Based on the priority of the smart environment, we can conclude that the government's commitment to supporting environmental welfare and ecological resilience is not yet comprehensive and is still focused on efforts to improve the quality of short-term waste management because there are no visible long-term waste management efforts, such as 3R (reduce - waste management, reuse, recycle) in a systematic and structured manner (Pemerintah Kota Bandung, 2021).

Problems that were born

In the identification and evaluation of this study, it was found that communication, resources, disposition, and bureaucratic structure are some of the problems that hinder the implementation of smart city policies in Bandung City (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). If seen from a communication perspective, this is related to uneven socialization. This causes the community and related parties to have difficulty implementing Bandung's smart city policy. The general unawareness of systems and applications arises from the limited publication of relevant information. The Bandung City Government currently faces a shortage of personnel in Science and Technology, which is crucial for the effective implementation of Smart City policies (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). To overcome this problem, adding employees alone is not enough; smart city implementation policies require employees who are experts and proficient in technology. In terms of information, there are several problems with information indicator resources, such as a lack of understanding by officers about the functions and responsibilities required to run the Smart City program. Apart from that, the apparatus's ignorance of technology makes the Smart City program less effective (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022).

Many problems still need to be fixed in terms of internet service infrastructure components, apart from the development side. Cables, society's main communications infrastructure, are still a mess, which is a significant problem. Apart from that, the internet services provided to the public are not yet evenly distributed and optimal. Infrastructure is the most important because only with adequate infrastructure can development be carried out effectively and efficiently (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). The Bandung City Smart City program is hampered by limited internet access in various places. This is because the Bandung City Government still rents bandwidth from third parties and does not yet have its own infrastructure. Based on these needs, the Bandung City Government does not yet have standards (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022). At the beginning of the implementation of smart government in the ranks of the Bandung City Government, it was not yet accompanied by the readiness of supporting infrastructure, such as the internet. Aspects of the bureaucratic structure are also obstacles in their own right, including that the Operating Procedures cannot be understood by Bandung City Government employees (Pramadi, Fathy and Arifa, 2023; Wahyudi, Widowati and Nugroho, 2022).

Implications

Based on an assessment carried out by the Bandung City Government, the implementation of the smart city master plan in Bandung City has not been optimal. It can be seen from the scores obtained that none of them is close to 100. However, this assessment cannot even describe how the implementation of smart cities brings benefits and meets the city's needs and its people. If we look at the fulfillment of needs, the implementation of this master plan still leaves a lot of room to be able to support the sustainability and resilience of the city, which is the long-term goal of this smart city.

Based on the initiatives, the smart city master plan and its evaluation hold many opportunities to support the sustainability and resilience of the city, as shown previously. Evaluation based on the concepts of urban sustainability and resilience produces information on initiatives that support urban sustainability and resilience, and how they can lead to these two concepts. The results of this study analysis provide an overview of what steps the government has or has not successfully taken to support urban sustainability and urban resilience based on its dimensions. These results can be input for the government in efforts to achieve urban sustainability and urban resilience, which must be the government. This evaluation is suitable to be applied to cities with smart city implementation, such as in Indonesia, which has not focused 100% on the use of information and communication technology, as in developed countries, where it can be accessed in real time by the entire community. The implementation of smart city in the city of Bandung only focuses on the use of technology for certain purposes, such as using applications to obtain certain services.

This study is different from Ding, Huang and Xiao (2023), which used big data to compare daily work and residential activities with plans in the master plan to obtain findings regarding the importance of a master plan that is more people-oriented than building-oriented. Ding et al's research is spatial, so it is in a different area from this study, which talks about programs and strategies. Likewise, Buzási, Jager and Hortay (2024)

emphasized the importance of spatial analysis in examining urban sustainability gaps in several cities.

This study also shows the importance of prioritization in implementing the master plan to obtain the expected impact in urban sustainability and urban resilience, and prioritizes qualitative understanding of city needs and problems, in line with Hodson *et al.* (2023), who emphasize the importance of qualitative understanding of human experiences and their social impact. However, this is in contrast to Yan, Liu and Tseng (2020), who assess smart cities based on technological aspects as dimensions of smart city development, namely smart cells, ICT, and development mechanisms.

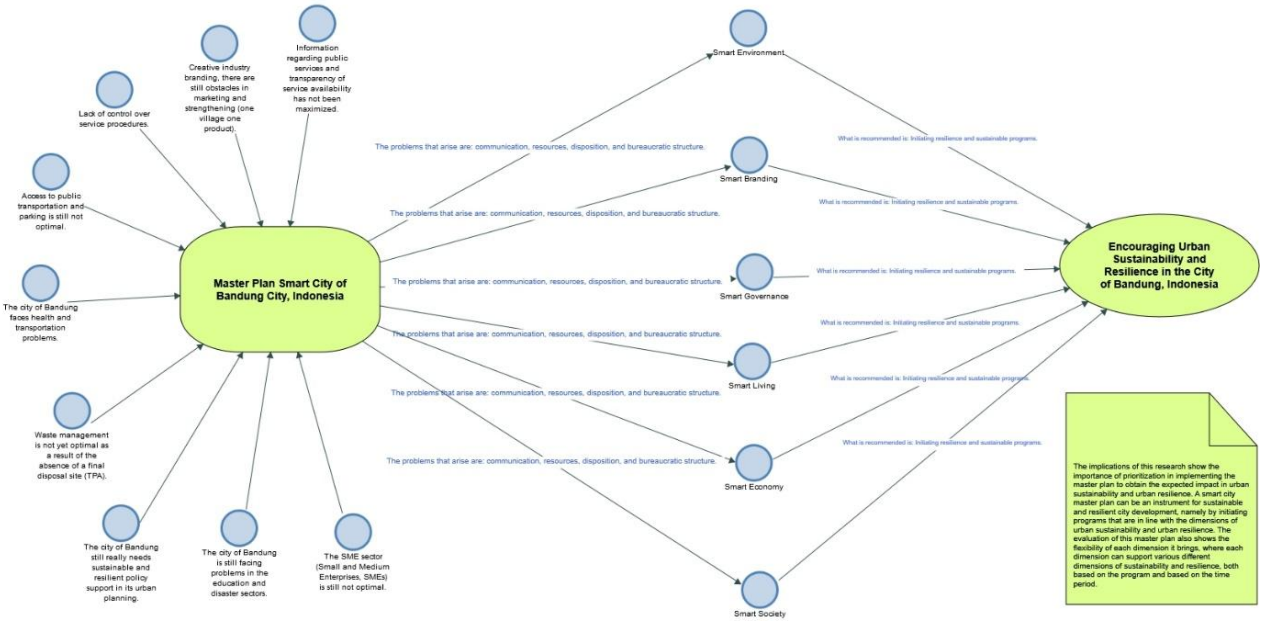
Master Plan Smart City of Bandung City, Indonesia
Encouraging Urban Sustainability and Resilience in the City of Bandung, Indonesia
Smart Environment
Smart Branding
Smart Governance
Smart Living
Smart Economy
Smart Society
Information regarding public services and transparency of service availability has not been maximized.
Creative industry branding, there are still obstacles in marketing and strengthening (one village one product).
Lack of control over service procedures.
Access to public transportation and parking is still not optimal.
The city of Bandung faces health and transportation problems.
Waste management is not yet optimal as a result of the absence of a final disposal site (TPA).
The city of Bandung still really needs sustainable and resilient policy support in its urban planning.
The city of Bandung is still facing problems in the education and disaster sectors.
The SME sector (Small and Medium Enterprises, SMEs) is still not optimal.
The problems that arise are: communication, resources, disposition, and bureaucratic structure.
What is recommended is: Initiating resilience and sustainable programs.
The implications of this research show the importance of prioritization in implementing the master plan to obtain the expected impact in urban sustainability and urban resilience. A smart city master plan can be an instrument for sustainable and resilient city development, namely by initiating programs that are in line with the dimensions of urban sustainability and urban resilience. The evaluation of this master plan also shows the flexibility of each dimension it brings, where each dimension can support various different dimensions of sustainability and resilience, both based on the program and based on the time period.

Figure 3: Schematic Model of Smart City Challenges and Opportunities for Bandung City in promoting sustainable and resilient urban areas. *Source:* NVivo 12 Plus, 2024

Based on figure 3, this study shows that a smart city master plan can be an instrument for sustainable and resilient city development, namely by initiating programs that are in line with the dimensions of urban sustainability and urban resilience. The evaluation of this master plan also shows the flexibility of each dimension it brings, where each dimension can support various dimensions of sustainability and resilience, both based on the program and based on the period. Therefore, the government and related stakeholders need to pay attention to the direction of programs and initiatives in the smart city master plan and determine priorities so that an optimal impact can be obtained on urban sustainability and urban resilience in Bandung City, Indonesia.

The Smart City Master Plan of Bandung City (2018-2023) emphasizes integrating technology and governance to enhance urban sustainability and resilience. Recent studies illustrate that the implementation of smart governance, through the optimization of E-Government platforms and community engagement initiatives such as "Bandung

Sadayana," promotes transparency and participation among citizens (Haryani, Putri and Jannah, 2024; Kesuma and Yulianto, 2023). These platforms enhance public service efficiency and empower residents to actively participate in urban planning and decision-making processes. This participatory approach is vital in addressing local challenges and tailoring solutions that cater to the unique socio-economic and cultural fabric of Bandung, thereby improving urban resilience against various socio-environmental pressures (Erza, Suparmoko and Tambunan, 2022; Kusumastuti and Rouli, 2021). The plan also focuses on utilizing advanced technologies to improve resource management, optimize traffic flow, and develop a robust waste management system, aligning with the Sustainable Development Goals (SDGs) (Afira and Wijayanto, 2022; Ammara *et al*., 2022).

Furthermore, the Smart City Master Plan features a strategic framework that promotes collaborative initiatives among government, private sectors, and civil society, fostering an integrated urban environment. By employing a multi-faceted approach that includes smart living, smart environment, and smart economy dimensions, Bandung aims to address critical urban issues such as traffic congestion, pollution, and inefficient resource utilization. The incorporation of data analytics and digital infrastructure enables real-time decision-making and responsive governance, essential for enhancing the city's adaptive capacity to challenges like climate change and public health crises, as evidenced by studies of health system resilience during the COVID-19 pandemic. Such innovative urban strategies underscore Bandung's commitment to achieving immediate sustainability objectives and building long-term resilience against future urban challenges.

Comparison of the implementation of smart city in Bandung and several cities in Indonesia such as Jakarta, Surabaya City, Makassar City, and Semarang City, can be seen in different innovations and characteristics (Jakarta Smart City, 2023; Pemerintah Kota Makassar, 2019; Pemerintah Kota Bandung, 2021; Pemerintah Kota Semarang, 2018; Pemerintah Kota Surabaya, 2023): Bandung City focuses on administrative services and citizen participation (Citizen complaint, Silakip, Command Center); Jakarta is seen in comprehensive and mature in service integration (Smart City Lounge, JAKI, JakLingko, Smart Building); Surabaya City focuses on solid operations and is globally recognized (Command Center 112). Makassar City focuses on innovation, advanced in technology and virtual services (Online services, Makverse, smart health), and Semarang City focuses on service speed, participation, and the environment (Libas Application, Trans Semarang, urban agricultural villages). Bandung City stands out in its digital administration system and community engagement through platforms such as Hay U, SIP, and command centers. Jakarta is proven to be more comprehensive, covering transportation, public complaints, health, and government efficiency with the latest technology. Surabaya City excels in public service integration and has received international recognition as an innovative smart city. Makassar City is moving towards digitizing urban services and marginalized governance through new concepts like Makverse. Semarang City has developed an inclusive, environmentally friendly, and citizen-participatory smart city ecosystem.

Policy and Practice Recommendation

Based on the results of this research study, the policy and practice recommendations are: (1) Enhancing Transparency and Accountability: Local governments should implement open data initiatives that allow citizens to access information regarding city planning,

budgets, and project outcomes. This could involve creating a centralized online platform where residents can view real-time data on city services, expenditures, and performance metrics. Regular public reports and audits should also be mandated to ensure accountability and build trust between the government and the community; (2) Increasing Citizen Engagement: To foster greater public participation in governance, local authorities should establish structured channels for citizen feedback, such as town hall meetings, online surveys, and participatory budgeting processes. These platforms should be designed to encourage diverse community input, ensuring that marginalized groups have a voice in decision-making. Additionally, the government could organize workshops and forums to educate citizens about smart city initiatives and gather their insights on urban challenges; (3) Strengthening Inter-Agency Collaboration: The local government should promote collaboration among various departments and agencies involved in urban planning and service delivery. This can be achieved by forming cross-functional teams that focus on specific urban issues, such as transportation or waste management. Regular inter-agency meetings and joint projects can facilitate knowledge sharing and ensure that initiatives are aligned with the overall goals of urban sustainability and resilience. (4) Investing in Capacity Building: Local governments should prioritize training and capacity-building programs for public officials and staff involved in smart city initiatives. This could include workshops on data analysis, project management, and community engagement strategies. By enhancing the skills of government personnel, the city can improve the implementation and monitoring of smart city projects, leading to more effective governance. (5) Leveraging Technology for Citizen Services: The government should invest in user-friendly digital platforms that streamline access to public services, such as permitting, reporting issues, and accessing information. Mobile applications and online portals can facilitate communication between citizens and government agencies, making it easier for residents to engage with local governance and report concerns; and (6) Establishing Performance Metrics: To ensure that smart governance initiatives are effective, local authorities should develop specific performance metrics that measure the impact of governance strategies on urban sustainability and resilience. These metrics should be regularly reviewed and adjusted based on feedback from citizens and stakeholders, allowing for continuous improvement in governance practices.

The policy and practice recommendations of this study are: (1) The importance of proper understanding (in terms of quality of life, mobility, and connectivity, as well as inclusiveness in city development schemes), policies of smart city implementation, and strategic measures carried out in urban transformation efforts through smart cities are based on needs that need to be prepared by City Ruler (the Local Government); (2) The importance of key operations in terms of initiation and strategic priorities for smart city implementation (in terms of adequate infrastructure development and public participation) in overcoming urban problems; dan (3) Even though there is transformative urban potential through a smart city in the City of Bandung towards a resilient and sustainable city, the trend that has occurred in the City of Bandung in terms of its realization to date is still not optimal. So it requires many key scientific and operational steps in its implementation (in terms of coordinated and integrated implementation).

Conclusion

This study seeks to analyze how the smart city master plan in Bandung City and its implementation can support the city's sustainability and resilience. Even though there are still many targets that have not been achieved, the initiatives offered by this master plan have led to the sustainability and resilience of the city. Even though there are still many urban challenges such as increasing energy and water consumption, pollution, greenhouse gas emissions, social discrimination, and disaster risk management issues which are the main issues of sustainable urban development (Rehm, McLoughlin and Maccani, 2021) have not yet become a top priority, However, there have been initiated efforts by the government to go in that direction.

Previous research regarding master plan evaluation and urban sustainability and urban resilience assessments in other cities is difficult to replicate in the case of smart cities, cities in Indonesia that have different viewpoints and approaches in their implementation, and master plan documents that are not spatial and detailed. This study raises aspects of smart cities that are in line with the concepts of urban sustainability and urban resilience. By reviewing the initiatives carried out in this paper, the government and related stakeholders can determine the efforts that will be made to achieve the goals of urban sustainability and/or urban resilience in future planning. Currently, master plan evaluation is commonly carried out in Indonesia only as part of the planning process, namely as part of city planning, where it only includes the percentage of successful implementation of a program and does not assess based on its objectives in achieving a certain outcome, especially urban sustainability and urban resilience.
This study has limitations in analysis, where there is no quantitative analysis that can support the evaluation results in formulating specific steps to improve the quality of smart city implementation in the future. This is due to limited data and relevant sources of information, especially as a result of the form of planning documents that do not support carrying out this analysis.

Ultimately, Bandung's Smart City Master Plan represents a crucial step toward sustainable and resilient urban development. By refining its strategies and prioritizing inclusivity, public participation, and measurable progress, Bandung can position itself as a leading model for smart city development, contributing to broader global discussions on sustainable urban futures.

Science Highlights:

(1) The Smart City Masterplan is a smart city construction and development planning document in the form of program initiatives along with a road map.
(2) The smart city master plan is an IT-based city transformational effort, and efficiency and innovation practices that have many opportunities to support city sustainability and resilience.
(3) The implementation of the smart city in the city of Bandung only focuses on the use of technology for certain purposes, such as using applications to obtain certain services. The implementation of the Bandung City smart city master plan is a transformative step in realizing urban resilience.
(4) Implications in the implementation of the Bandung City Smart City master plan are an important study and reference material for the city government and local authorities in planning and initiating inclusive, safe, resilient, and sustainable city development.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*	*Author 4*	*Author 5*	*Author 6*
Conceived and designed the research or analysis	Yes	No	No	No	Yes	No
Collected the data	Yes	Yes	No	No	No	No
Contributed to data analysis & interpretation	Yes	No	No	No	Yes	No
Wrote the article/paper	Yes	No	No	Yes	No	Yes
Critical revision of the article/paper	No	Yes	Yes	Yes	No	No
Editing of the article/paper	No	Yes	No	No	No	No
Supervision	No	No	Yes	Yes	No	No
Project Administration	Yes	Yes	Yes	No	No	No
Funding Acquisition	Yes	Yes	Yes	Yes	No	Yes
Overall Contribution Proportion (%)	30	20	15	15	10	10

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The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

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